BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION

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In the Matter of	)	
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Amendment of Parts 2 and 25 of the	)	ET Docket No. 98-206
Commission's Rules to Permit Operation of	)	RM-9147
NGSO FSS Systems Co-Frequency with	)	RM-9245
GSO and Terrestrial Systems in Ku-	)	
Band Frequency Range	)	
	)	
and	)	
	)	
Amendment of the Commission's Rules to	)	
Authorize Subsidiary Terrestrial Use of the	)	
12.2-12.7 GHz Band of Direct Broadcast	)	
Satellite Licensees and Their Affiliates	)	

COMMENTS ON NOTICE OF PROPOSED RULEMAKING

I. INTRODUCTION

In its Notice of Proposed Rulemaking ("NPRM"), ET Docket No. 98-206 the Federal Communications Commission ("Commission") *inter alia* solicits comments on its proposal to permit non-geostationary satellite orbit ("NGSO") fixed satellite service ("FSS") operations in the Ku-Band, and requests comments on its proposed rules and policies to govern such operations. The Commission also requests comments on a Petition for Rulemaking filed by NorthpointTechnology on March 6, 1998, RM-9245 to permit terrestrial use of the 12.2-12.7 GHz band for the retransmission of local television and provision of one-way data services by terrestrial broadcast providers on a secondary basis to broadcast satellite service ("BSS") operations. Denali Telecom, L.L.C. ("Denali") has an application pending before the

Commission for Authority to Launch and Operate Thirteen Satellites in the Pentriad System in the International Fixed-Satellite Service and the Mobile Satellite Service, filed September 27, 1997, 160-SAT-P/LA-97, the "Pentriad System" and wishes to comment on the issues raised in the NPRM.

II. THE COMMISSION SHOULD CONSIDER ALL TYPES OF NGSO SYSTEMS IN ITS RULEMAKING

In the Commission's Introduction to the NPRM, it was evident that there is a tendency to consider that all NGSO systems have similar characteristics and that those characteristics are similar to LEO systems such as proposed by SkyBridge. For example, the Commission notes in its footnote one to the NPRM that:

> NGSO systems. . . . are characterized by a constellation of satellites continuously orbiting the earth, rather than appearing to remain stationary relative to a user as a geostationary satellite ["GSO"] does. NGSO satellites generally operate at lower altitudes and therefore appear to move from horizon to horizon. As the NGSO satellites move through their orbit, they transmit to and receive from earth stations that are in view of the satellite. [In contrast,] [g]eostationary satellites orbit 22,300 miles above the Earth in the plane of the Earth's equator. At this altitude, the geostationary satellite's position appears fixed relative to an observer on Earth. *NPRM at n1.*

There are numerous NGSO system constellations that do not share the characteristics cited above. NGSO systems can appear to remain quasi-stationary to a user. Not all NGSO's appear to move from horizon to horizon. Not all NGSO satellites operate at low altitudes. The characteristics cited by the Commission are common only to LEO systems similar to those proposed by SkyBridge.

For example, Quasi-GEO NGSO systems, such as the Pentriad System, differ from

SkyBridge-type LEO NGSO systems. The Commission has recognized in other parts of the NPRM that there are significant differences in types of systems being proposed for the Ku-band spectrum. LEO, MEO and HEO NGSO systems are being proposed. Consequently, we urge the Commission to avoid characterizing NGSO systems with attributes that fit only one type of NGSO system and to incorporate the diversity of NGSO systems in its development of rules and policies for satellite systems operating in the Ku-Band.

In particular, the Commission should incorporate the characteristics of the type of satellite orbit generally referred to as a quasi-geostationary satellite orbit ("Quasi-GEO") which uses a particular subset of highly elliptical orbits ("HEO"). The Commission currently has one pending applications of this type, (Pentriad,160-SAT-P/LA-97/13) and several systems of this type have been in operation in Russia since 1965.1 Furthermore, several new systems of this type have been proposed abroad. (PETALRING 30C-K, AR11/A/1077; PETALRING 30C-S, AR11/A/1078 MOD-1; PETALRING 60E-S, AR11/A/1079; QUASIGEO-L1,L2, AND L3, AR/11/B/379; TONQUASI-1, AP1/A/7).

Quasi-GEO systems are characterized by use of HEO inclined at an angle of approximately 63 degrees from the equatorial plane. The satellite phasing and orbit geometry of Quasi-GEO systems result in provision of service from satellites which are active in small windows of space. Those small windows appear to be geostationary, even though the satellites themselves are not stationary. The significance of this distinction is that earth stations tracking such satellites essentially point in a fixed direction similar to the GSO systems. This

1 Soviet Space Programs 1976-80, with Supplemenatry Data Through 1983, Unmanned Space Activities, (United States Senate, May 1985).

characteristic enables the Quasi-GEO systems to be compatible with GSO systems through spatial diversity. Sharing of the same frequency spectrum by GSOs and Quasi-GEO systems is therefore both spectrally and spatially efficient. On the other hand, SkyBridge-type LEO NGSO systems must extensively coordinate operations so as to not interfere with the GSOs (*See NPRM at paragraph 75).* No such coordination measures need to be taken by Quasi-GEOs since Quasi-GEO systems have a high degree of angular separation, generally in excess of 45 degrees.

III. THE UNIQUE CHARACTERISTICS OF THE QUASI-GEO MERIT DIFFERENT TREATMENT IN COMMISSION POLICY AND RULE-MAKING

As demonstrated above, Quasi-GEO systems have characteristics that are distinct from SkyBridge-type LEO NGSO systems and do not require extensive procedures for coordination with the GSOs. Consequently, the Commission should not impose rules on the Quasi-GEO systems which are identical with SkyBridge-type LEO NGSO systems, as such rules are unnecessary for the protection of the GSOs and would be burdensome to the Quasi-GEO system operations.

For example, the Commission, "in the interest of furthering the creation of a seamless global communications network" proposes to adopt the same coverage requirement for all NGSOs that is currently applied to LEO NGSO systems operating in the 1610-1626.5/2483.5-2500 MHz frequency bands and the LEO NGSO systems in the 17.7-20.2 GHz and 27.5-30.0 GHz band ("Big LEOs"). *NPRM at paragraph 84.* The Commission proposes to require systems operating in the Ku-Band to "serve locations as far north as 70 degrees latitude and as far south as 55 degrees for at least 75% of every 24-hour period." *Id.* Denali strongly opposes such a "full

global coverage" requirement for all NGSO systems in the Ku-Band.

Quasi-GEO systems have characteristics which do not lend them to such a requirement. Depending upon the orbital period chosen, Quasi-GEO systems can be focused on one or more service areas much like a GEO satellite is focused on a particular service area. The difference between the GSO and Quasi-GEO is that the nadir boresight of the Quasi-GEO beam can be located between approximately 40 degrees and 63 degrees (either North or South Latitude, but not both). It would be inefficient to impose a global coverage requirement on the Quasi-GEOs. Quasi-GEOs can "focus" there service capacity unlike the LEO/MEO type systems.2

The Commission should allow market forces to determine which areas NGSO systems, including Quasi-GEO systems, will cover. A global coverage requirement would "tie up" and "waste" capital on space segment capacity for which there may not be a market. A global coverage requirement would necessitate a greater number of satellites in a Quasi-GEO constellation and thereby impose an unnecessary cost on such providers.

The Commission notes that it is important to accommodate, if technically feasible, multiple NGSO FSS systems to promote greater competition in the satellite industry. *NPRM at paragraph 67.* The Commission should allow satellite providers to develop the most market-driven system possible while still ensuring that the spectrum can be readily shared with GSO and NGSO systems. This can best be accomplished through refraining from imposing a global

2 We note that no "global" coverage requirement is being proposed for GSO systems. GSO systems are allowed to choose their service areas determined by market requirements. NGSO systems should be given the same business options as GSO systems. To do otherwise would place NGSO systems at a distinct disadvantage in competition with GSO systems that serve only one hemisphere.

coverage requirement for NGSO systems, in particular for Quasi-GEO systems, when it is not required in order to establish an economically viable satellite system.

IV. THE COMMISSION SHOULD CONSIDER THE UNIQUE CHARACTERISTICS OF THE QUASI-GEO IN APPORTIONING THE BURDEN OF SPECTRUM SHARING

The Commission proposes that all NGSO FSS systems should be responsible for some portion of burden-sharing. *NPRM at paragraph 70.* In theory this sounds acceptable and we do not wish to assert that the burden of sharing should be borne by all types of NGSO systems other than Quasi-GEO systems. However, once again the particular characteristics of each type of NGSO system should be taken into account when considering the relative burden of any type of sharing technique. A technique that may be easily accommodated by one type of NGSO system may prove intolerable to another type of NGSO system. For example, if Quasi-GEO systems were to be required to have the capability to dynamically switch service to any ground station from a satellite in one service window to another satellite in a different service window, the ground segment costs would be dramatically and unacceptably increased. Such a sharing technique could have the ironic effect of reducing the number of systems that can operate by tying up usable service windows. On the other hand, Quasi-GEO system could compromise on the size and shape of the service windows of the satellites. In allocating the burden of sharing, the Commission should consider such factors as whether the system in question can co-exist with other systems without substantial mitigation techniques. The greater degree to which a system can co-exist with other systems, the less that system should be required to do with regard to mitigation techniques. The more compatible a particular type of NGSO or Quasi-GEO is with

the GSOs, the more such systems should be encouraged to share the band and not have restrictions imposed.

The Pentriad System allows for multiple uses of the frequency spectrum. Because the operational service are of the satellites is between 44.8 degrees North Latitude and 63.5 degrees North latitude, Pentriad can operate, without interference, or use of interference avoidance mitigating techniques because there is an effective separation of approximately 40 degrees between GEO satellites and the operational arc of the Denali Quasi-GEO satellites.

The Pentriad system design also allows for the implementation of multiple systems in other Quasi-GEO type orbits by maintaining spatial diversity between the service windows of the satellites. Denali estimates that with twelve (12) longitudinal degrees spacing, up to six systems orbital parameters similar to Pentriad could operate without the use of interference mitigation or mutually harmful interference. Denali also could achieve coordination with SkyBridge-type LEO NGSO by using spatial diversity and/or carefully coordinating the systems. The achievement of such coordination will involve consideration of factors which are too numerous to discuss here.

Virtual Geosatellite, L.L.C. ("Virtual Geo") has also filed an application with the Commission, seeking authority to launch and operate a system of satellites ("VIRGO") which is similar to a Quasi-GEO in that the Virgo satellites also would be separated from the geostationary arc by at least 40 degrees within the system's service areas. (*See*, SAT-LOA-1900108-0007 at page iii.) The VIRGO system, as compared to a SkyBridge-type LEO NGSO system, appears to be able operate on a co-frequency and co-coverage basis with GSOs. However, the VIRGO system, as opposed to Quasi-GEO systems, cuts a large east-west swath

which makes it difficult to achieve coordination with both SkyBridge-type NGSO and Quasi-GEO systems. One VIRGO system would interfere with multiple Quasi-GEO systems resulting in less efficient usage of both frequency spectrum and orbital space.

V. THE COMMISSION SHOULD ADOPT LESS STRINGENT EPFD LIMITS FOR THE PROTECTION OF GSO FSS DOWNLINKS THAN THOSE PROPOSED BY THE WORLD RADIOCOMMUNICATION CONFERENCE IN RR. S.22

The Commission seeks comments on the adequacy of the provisional equivalent power flux density ("epfd") limits for protection of GSO FSS downlinks contained in RR S.223 and noted in Table 1, "EPFD Limits to Protect GSO FSS Systems" ("Table 1") *Paragraph 26 of the NPRM.* Denali urges the Commission to consider alternative epfd limits in the interest of seeking an accommodation that is acceptable to both GSO and NGSO operators.

The epfd limits provided in Table 1 (also hereafter referred to as "RRS.22") were examined by JTG 4-9-11 and included the review of proposals submitted by the administrations of the Untied States, Canada, France, and Intelsat. Russia also participated in the discussions and review of RR S.22. These limits are single entry limits that constrain interference into a GSO FSS downlink from a single NGSO system, and reflect the concerns of these administrations that the provisional limits are not adequate to protect GSO FSS downlinks. In general, these proposals advocate an *aggregate* epfd limit that is *more* stringent than the *single entry* limit of RR S.22. Although calculation of epfd from NGSO systems into GSO FSS earth stations is computationally straightforward, representatives of NGSO and GSO systems have generally disagreed on what constitutes an acceptable level of interference into a GSO system.

3 Final Acts of WRC 97, p.106, Table S22-3.

The Joint Task Group ("JTG") has recognized the need for further work to address these concerns and has requested that WP4A further refine and validate the epfd masks that would be required to protect GSO FSS carriers.

Although the epfd limits desired by the GSO operators are considerably more stringent than those contained in RR S.22, in the interests of seeking an accommodation that is acceptable to both GSO and NGSO operators, Denali proposes that the Commission adopt the following modification to RR S.22, set forth in Table A *infra*, which Denali believes to be an acceptable compromise. Specifically, Denali proposes that the Commission adopt limits more stringent than the provisional limits adopted by WRC-97 until such time that the work of the ITU technical groups has been completed and a sound technical basis has been established for a revision to the provisional limits. Denali proposes that the epfd limits shown in Table A, which constitute a composite of the proposals made to JTG 4-9-11 by the several administrations noted *supra*, be adopted as the *single entry* epfd limits of Table 1.

The epfd limits for both long and short term of Table A proposed herein are not as stringent as those previously proposed, as Denali proposes single entry limits rather than aggregate limits. However, the limits Denali proposes herein *are* significantly more stringent than the provisional epfd limits currently in RR S.22. Denali believes that the epfd limits proposed in Table A will better protect GSO FSS links until such time that the ITU technical committees develops a sound technical basis for a permanent revision to the provisional limits of RR S.22. Denali also maintains that these limits are compatible with many NGSO systems.

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4 These proposals are contained in the *Report of the Third Meeting of JTG-4-9-11*, Long Beach, USA, January 19-29, 1999, Section 11.4, p.30.

TABLE A

RECOMMENDED MODIFICATIONS TO PROPOSED EPFD LIMITS TO PROTECT GSO FSS SYSTEMS

Frequency Band (GHz)	Equivalent pfd dB (W/m^2)	Percentage of time during which equivalent pfd level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern
10.7-12.2	-183	90.0	4	60 cm, Rec. ITU-R S.465-5
	-189	90.0	4	1.2 m, Rec. ITU-R S.465-5
	-196	90.0	4	3 m, Rec. ITU-R S.465-5
	-202	90.0	4	10 m, Rec. ITU-R S.465-5
	-183	99.0	4	60 cm, Rec. ITU-R S.465-5
	-189	99.0	4	1.2 m, Rec. ITU-R S.465-5
	-196	99.0	4	3 m, Rec. ITU-R S.465-5
	-202	99.0	4	10 m, Rec. ITU-R S.465-5
	-177	99.9	4	60 cm, Rec. ITU-R S.465-5
	-186	99.9	4	1.2 m, Rec. ITU-R S.465-5
	-192	99.9	4	3 m, Rec. ITU-R S.465-5
	-202	99.9	4	10 m, Rec. ITU-R S.465-5
	-174	99.95	4	60 cm, Rec. ITU-R S.465-5
	-185	99.95	4	1.2 m, Rec. ITU-R S.465-5
	-191	99.95	4	3 m, Rec. ITU-R S.465-5
	-202	99.95	4	10 m, Rec. ITU-R S.465-5

VI. THE PROVISIONAL EPFD LIMITS PROPOSED BY THE WORLDRADIOCOMMUNCIATION CONFERENCE OF 1997 SHOULD NOT BE ADOPTED UNTIL MORE TECHNICAL ANALYSIS IS CONDUCTED

The Commission seeks comment on the provisional power flux density ("pfd") limits adopted by WRC-97 as to whether such limits are adequate to protect 45 cm dishes that are used in the United States if multiple NGSO FSS systems are deployed in this band. *See paragraph 59 of the NPRM.* The Commission notes that it is not convinced that the provisional pfd limits adopted by WRC-975 are adequate to protect 45 cm dishes in use in the United States in the Broadcast Satellite Service, ("BSS") especially if multiple NGSO systems are permitted to

5 Final Acts of the World Radiocommunication Conference of 1997, Table S22-1.

operate within the BSS band. Indeed, as reported by JTG 4-9-116 ("ITU Working Group")

> "several analyses ... have indicated that small offset fed antennas commonly used in BSS earth stations in Region 2 may have sidelobes of significant amplitude that exhibit a wide angular extent in some axial planes."

The ITU Working Group also noted that these higher level sidelobes are generally in directions away from the geostationary arc.

The ITU Working Group has recommended that a three dimensional pattern based on measurements made on 45 cm antennas in the 12.2-12.7 GHz band be used for non-GSO interference analyses on a provisional basis until reviewed by WP 10-11S. These experimental patterns clearly show the increased sidelobes resulting from use of a low cost, offset fed antenna of the type used in the BSS. However this three dimensional pattern is difficult to apply and should not be the basis for regulation until it is adequately reviewed and formally adopted by the ITU.

Denali shares the Commission's concern that the provisional epfd adopted by WRC-97 does not adequately protect 45 cm offset-fed antennas of the type commonly used in the Broadcast Satellite Service. Until there is an approved technical basis from the ITU for epfd limits for 45 cm antennas, Denali recommends that the additional protection be implemented through adopting efpd limits of the 60 cm antenna for Regions 1 and 3 in lieu of the 45 cm efpd limits provided in Table S22-1 for Region 2. This lower equivalent PFD level will serve to at least partially compensate for the higher sidelobes exhibited by typical 45 cm offset fed antennas as commonly used in the Broadcast Satellite Service.

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6 Report of the Third Meeting of JTG 4-9-11, Long Beach, USA January 19-29, 1999 at page 9.

VII. THE COMMISSION SHOULD NOT ESTABLISH BLANKET "EXCLUSION ZONES," AS SUCH A RULE WOULD CREATE A DETRIMENTAL COST IMPACT TO CERTAIN NGSOs WITHOUT JUSTIFICATION

The Commission proposes establishing "exclusion zones" around the 50 most populated cities with the goal of providing a "workable compromise to ensure fixed service growth and enable NGSO FSS gateway deployment. " *NPRM at paragraph 24.* Denali urges the Commission to consider an alternative rule to a blanket exclusion zone to ensure the expansion of terrestrial services.

If the elevation angles of a given NGSO system is sufficiently high (20-30 degrees), a large "exclusion zone" would be not be necessary to protect terrestrial services. Such a large exclusion zone would only serve to substantially increase the number of microwave "hops" necessary for NGSO operations, and result in higher terrestrial interconnection costs for NGSO systems, without adding any benefit to terrestrial service providers. However, Denali recognizes that NGSOs operating at lower elevation angles (5-10 degrees) could pose interference problems with terrestrial providers. Therefore, Denali proposes that the Commission adopt a rule which acknowledges the factor of low elevation in creating interference with terrestrial providers. For example, the Commission could adopt a rule which stipulates that NGSO systems which operate at low elevation angles must provide protection to and from terrestrial providers, through efpd limits that are elevation angle dependent. The Commission should weigh the cost impact on NGSO systems and the attendant benefit to terrestrial providers in implementing any operational requirements related to major exclusion "zones" around the most populated cities.

VIII. THE COMMISSION SHOULD NOT PERMIT DBS PROVIDERS TO OPERATE IN THE 12.2-12.7 GHz BAND, AS SUCH FREQUENCY SHARING MAY CAUSE INTERFERENCE WITH GSO AND NGSO SYSTEMS

Northpoint Technology's ("Northpoint") Petition for Rulemaking, *RM-9245, filed March 6, 1998* ("Petition") requesting rulemaking for the provision of terrestrial retransmission of local television signals and one-way data services to DBS receivers in the 12.2-12.7 GHz band on a secondary basis to BSS operations. The Commission notes that the NGSO FSS systems and the proposed Northpoint technology may not be able to operate compatibly. *NPRM at paragraph 96.* Denali shares this concern.

Northpoint does not make a technical showing that their terrestrial use of 12.2 -12.7 GHz band will not interfere with FSS services. Further, Northpoint provides no technical details regarding the parameters of their system that would enable NGSO providers to determine compatibility of their system with other authorized uses of this band. Northpoint urges the Commission to rely on very limited testing which could potentially have a very significant impact on both geostationary BSS and NGSO use of the band as primary users. Northpoint should be required to make a technical showing with appropriate technical detail that their desired use of the band will not cause interference to other primary users of the band and other primary users should be afforded an opportunity to review such technical detail before a final determination is made.

The technical claims Northpoint makes in its Petition are made without any technical showings. For example, Northpoint makes reference to an ability to support a "reliable service area" of 10 miles "despite approximately 19 dB of ground attenuation." *See,* Petition for

Rulemaking by Northpoint Technology, page 16, March 6, 1998). However, Northpoint does not address what factors they have considered in determining the "reliable service area." Such a determination is important; even cellular service providers have found it necessary to incorporate margins. Northpoint also states that their testing has demonstrated that there is no perceptible interference between their transmission and those of DBS provided that they maintain a C/I ratio. This claim seems implausible, and Northpoint offers no supporting technical details.

Northpoint maintains throughout its Petition that it must be granted access to the same band used by DBS service providers, namely 12.2 to 12.7 GHz, in order to provide its service. It states that its system would employ a second antenna at a DBS subscribers location pointed northward to receive its terrestrial broadcasts and that, to minimize the incremental cost to a DBS subscriber of adding capability to receive these terrestrial broadcasts, it must use the DBS receiver for reception of its broadcasts. This description is somewhat inaccurate. In order to make use of the DBS receiver, Northpoint must provide both an antenna pointed northward and a low-noise block down converter (LNB) with the DBS receiver. It cannot simply interconnect its antenna to the front end of the DBS LNB without significantly degrading the DBS reception. Since it must provide an LNB, the choice of transmission frequency is not limited to the band 12.2-12.7 GHz but can be any available frequency band, including those already authorized for terrestrial transmission as its LNB can be designed to down-convert its signals from other bands already authorized for use by terrestrial fixed services. Therefore, its service is not dependent on receiving authorization to use the 12.2-12.7 GHz band, but rather it could use bands currently authorized for this type of service without any cost impact to the DBS subscriber.

Northpoint acknowledges they would likely interfere with NGSO systems as well as GSO

systems. However, Northpoint still requests that the Commission consider the respective benefits to consumers of Northpoint technology, even at the peril of denying NGSO systems access to these bands. In fact NorthPoint's service cannot satisfy all DBS subscribers, such as those to the north of NorthPoint's service area and those that will experience interference due to proximity to NorthPoint's transmitter.

Although the elevation angles of the Quasi-GEOs will always be greater than 20 degrees (thus giving it an "off axis isolation advantage"), and spectrum sharing would pose less of a problem with systems such as Northpoint, the terrestrial system Northpoint proposes would interfere with NGSOs operations. The LEO systems, which use high inclinations and operate at low elevation angles, are oriented in a northerly direction. Such operations would be very close to the proposed boresite of the North Point user terminal beam, and would result in unacceptable interference into the NGSO receive terminals. These NGSO terminals will often point in the direction of the Northpoint transmitter resulting in a C/I below 0dB. Since Northpoint could effectively use other bands not assigned to either GSO or NGSO systems, and since many NGSO systems need a frequency allocation that is valid in all three ITU regions, the Commission should not allow fixed terrestrial service providers access to this frequency band. If Northpoint technology is judged to be of value, Northpoint should apply for use of bands already allocated to the fixed terrestrial service.

Respectfully submitted,
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